I claim:

1. A method of sputter deposition, comprising:

a) providing a plasma chamber with a sputtering gas disposed therein;

b) providing a material target disposed in the plasma chamber;

c) providing a pulsed DC power supply that periodically applies a voltage pulse to the material target, the voltage pulse ionizing the sputtering gas to create a plasma, the plasma adopting a highly ionized state without first adopting an arc discharge state; and

d) sputtering atoms from the target by bombarding the material target with ions from the plasma, the atoms being then deposited on the surface of a substrate in proximity to the plasma.

2. The method of claim 1, wherein the pulsed DC power supply delivers power greater than 0.1 MW with a peak power density greater than $1kW/cm^2$.

3. The method of claim 1, wherein the plasma adopts the highly ionized state without first adopting an arc discharge state by controlling the voltage rate of rise of the voltage pulse applied to the material target.

4. The method of claim 3, wherein the voltage rate of rise of the voltage pulse is controlled using a circuit comprising a resistor in series with a capacitor.

5. The method of claim 1, wherein the plasma adopts the highly ionized state without first adopting an arc discharge state by limiting the magnitude of the voltage pulse to a maximum level.

6. The method of claim 5, wherein the magnitude of the voltage pulse is limited using a circuit comprising a resistor in series with a capacitor.

7. The method of claim 5, wherein the magnitude of the voltage pulse is limited using a circuit comprising a reverse biased diode, a capacitor, and a clamp voltage supply.

8. A sputter deposition system, comprising:

a) a plasma chamber with a sputtering gas disposed therein;

b) a material target disposed in the plasma chamber;

c) a pulsed DC power supply that periodically applies a voltage pulse to the material target, the voltage pulse ionizing the sputtering gas to create a highly ionized plasma; and

d) pulse shaping circuitry that shapes the voltage pulse so as to allow the plasma to adopt a highly ionized state without first adopting an arc discharge state.

9. The sputter deposition system of claim 8, wherein the pulse shaping circuitry controls the voltage rate of rise of the voltage pulse.

10. The sputter deposition system of claim 9, wherein the pulse shaping circuitry comprises a resistor in series with a capacitor.

11. The sputter deposition system of claim 8, wherein the pulse shaping circuitry limits the magnitude of the voltage pulse to a maximum level.

12. The sputter deposition system of claim 11, wherein the pulse shaping circuitry comprises a reverse biased diode, a capacitor, and a clamp voltage supply.